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THESIS

PREDICTORS OF PLEBE SUMMER ATTRITION AT THE UNITED STATES NAVAL ACADEMY

by

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June 2003

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This thesis analyzes the relationship between entry-level variables available to the Office of Admissions and plebe summer attrition at the United States Naval Academy (USNA). The study used independent samples t-tests and linear regression analysis to analyze the effects of individual variables on plebe summer attrition and also used binary logistic regression to develop an overall predictive model of plebe summer attrition. Analysis was conducted on the USNA classes that completed plebe summer from 1995-2002 (N = 9,554). The results of this study indicate the highest plebe summer attrition is attributed to majority females, females in general and midshipmen who exceed the limits of the height/weight table and are not recruited athletes. The lowest plebe summer attrition rates are found among children of service academy graduates, recruited varsity athletes, summer seminar attendees, minority males and older midshipmen. This study summarizes the results and also offers recommendations to the Naval Academy and for future research.

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PREDICTORS OF PLEBE SUMMER ATTRITION AT THE UNITED STATES NAVAL ACADEMY

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I.   INTRODUCTION

A.   BACKGROUND

Founded in 1845 as the Naval School on old Fort Severn in Annapolis, the United States Naval Academy has a long history of developing exemplary leaders for both the naval service and the nation. Over 60,000 young men and women have successfully completed the "four years by the bay" and earned their commission as naval and Marine Corps officers (Naughton, 2003). Included among the graduates in the proud 157-year history of the Naval Academy are one President of the United States, 18 members of Congress, four governors, 50 astronauts and 33 Rhodes Scholars (USNA, 2003a).

As a publicly funded institution, the Naval Academy must adhere to the demands placed on it by both society and the elected leaders of the government. One way the Academy accomplishes this is by admitting a diverse student body that is increasingly more representative of both the fleet and societal populations (Nelson, 2002). One method the Naval Academy utilizes to maintain a diverse student body population while graduating exemplary leaders is a highly selective admissions process. Each year the Naval Academy selects approximately 1,200 candidates for admission from a total applicant pool in excess of 12,000 young men and women (USNA, 2002a). When a complete application for admission is received, the Naval Academy Admissions Board converts each applicant's responses, academic performance data, personality data and teacher recommendations into numerical values. These values are then entered into a formula that calculates an index known as the Whole Person Multiple (WPM). The WPM is then used to rank all applicants when considering them for admission (Black, 2001).

The Naval Academy is constantly searching for means to improve the admissions process. One measure of an improved admissions process is a reduction in the number of attritions. Due to the large applicant pool and competitive admissions process, every candidate who gains admission possesses the abilities needed to graduate, and it is a goal of the Naval Academy to see that happen whenever possible (D. Nelson, personal communication, February, 2003). However, it is inevitable that some amount of attrition will occur. For the most recent decade, the Naval Academy has experienced an average

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attrition rate of 22.6 percent (USNA, 2003b). Research shows that attrition occurs at the Naval Academy for a variety of reasons. Throughout their four years in Annapolis midshipmen are separated due to academic failure, conduct problems, honor offenses and a myriad of other reasons. Others will determine they are no longer interested in a military career and will voluntarily resign before incurring a mandatory service obligation at the start of their junior year (D. Nelson, personal communication, February, 2003). In the past eight years, approximately six percent of each class has been separated prior to the completion of plebe summer (USNA, 2003b). While it is not realistic (nor desired) to believe attrition can be completely prevented, understanding why attrition occurs may lead to strategies to improve the Naval Academy process.

B.   PURPOSE

The factors that cause plebe summer attrition are currently unknown. Virtually every person familiar with the Naval Academy has their own personal theory as to what the causes are, but all of these theories are purely speculative. Since Annapolis is known for hot and humid summer weather and Bancroft Hall lacks air conditioning, one popular theory stated by the Commandant of Midshipmen, Colonel John Allen, is plebe summer attrition is impacted by the weather (Col. J. Allen, personal communication, October, 2002). Another theory from the Admissions Office speculates that midshipmen who report with weight problems or out of shape will be more likely to resign during plebe summer (D. Nelson, personal communication, February, 2003). Additional theories from the Admissions Office speculate whether variables such as SAT scores, WPM, gender, race, summer seminar attendance, recruited athlete status and parent's military history can predict plebe summer attrition (D. Nelson, personal communication, February, 2003).

The purpose of this study is to answer the question, "What actually causes plebe summer attrition?" The objective is to identify factors (or combinations of factors) that are predictive of plebe summer attrition and provide this information to both the Naval Academy administration and to the Naval Academy Office of Admissions.

C.   EXPECTED BENEFITS

This study identifies the independent variables that significantly contribute to attrition from the Naval Academy during plebe summer. Understanding the causes of plebe summer attrition will provide several benefits to the Naval Academy. Plebe

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summer administrators will be able to adjust policies and scheduled events as necessary to manage attrition and improve the training process. The Admissions Office will be able to provide guidance to candidates on ways to prepare themselves for the rigors of plebe summer and reduce their risk of attrition. This study provides sound information on which to base future policies and decisions, preventing important decisions from being based on speculative theories instead of evidence.

D. SCOPE AND METHODOLOGY

1. Scope

This thesis is not an attempt to rewrite Naval Academy admissions policy, nor is it an attempt to eliminate otherwise qualified candidates for consideration from admission. Rather, this thesis exists to educate the Naval Academy administration, Admissions Office and midshipmen candidates on those factors that will lead to an increased risk of plebe summer attrition. A thorough analysis of related research in the fields of military and college attrition was conducted to identify variables most likely to impact plebe summer attrition. These studies, which are detailed in Chapter II, indicated race, gender, standardized test scores, parent's military experience, age and ability to meet height weight standards would impact plebe summer attrition. Speculation from the Admissions Office led to the inclusion of other variables such as Summer Seminar attendance, weather conditions and recruited athlete status. A research hypothesis was developed based on this research and tested by data analysis covering the entering classes from 1995-2002. Conclusions and recommendations were developed from the results of the analysis and are presented in Chapter V of this thesis.

Data for this study were obtained from the Data Warehouse maintained by the Office of Institutional Research, Planning and Assessment (IR) at the United States Naval Academy. This study is limited to the eight most recent classes to complete plebe summer due to height and weight information not being available for cohorts prior to the class entering in 1995. Other limitations include:

- This study is applicable only to the United States Naval Academy.
- Attrition coding in the data set does not distinguish attrition due to serious injury or family crisis. However, experience indicates this represents a very small

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number of midshipmen and is not expected to confound the results of the study (D. Nelson, personal communication, February 2003).

- Plebe summer exit interviews to identify extenuating circumstances for resignation were not conducted as part of this study.

Several critical assumptions have been made during this study. One of these is that the criteria for declaring a separated midshipman to have resigned during plebe summer (as opposed to the academic year) remained constant for the duration of the study. Another assumption is that overweight midshipmen can be identified solely by analyzing height and weight data, since body fat percentages are not available in the data set. A final assumption is that the data set is valid and accurate, containing all members of the entering classes of 1995-2002. These assumptions and limitations are not anticipated to significantly impact the results of this study nor are they expected to prevent the study from being generalized to future cohorts.

2. Research Questions

The research questions answered by this study are as follows:

- What Office of Admission entry-level variables, such as gender, race, age, summer seminar attendance, recruited athlete status, parent's military history, SAT scores and WPM are significantly related to plebe summer attrition?

- Is a midshipman's compliance with height and weight standards on induction day significantly related to plebe summer attrition?

- Is the weather (temperature) significantly related to plebe summer attrition?

- Can an empirical model be developed to identify which midshipmen are most likely to attrite during plebe summer?

Many of the variables addressed in the research questions were identified during the literature review as being predictors of attrition in similar environments. However, additional variables unique to the Naval Academy, such as summer seminar attendance, recruited athlete status and weather conditions, were obtained through discussion with Mr. Don Nelson, Assistant Dean of Admissions at the United States Naval Academy.

3. Methodology

Multivariate logistic regression analysis is utilized to identify predictors of plebe summer attrition. The dependent measure is plebe summer attrition, which is defined

dichotomously with midshipmen coded as either having completed plebe summer or not completed plebe summer. The independent measures are variables and combinations of variables including race, gender, SAT scores, WPM, family military history, summer seminar attendance, recruited athlete status, age, ability to meet height/weight standards at induction and plebe summer weather conditions. The results of this study are analyzed to provide conclusions and recommendations both to the Naval Academy and for further areas of study.

E.   ORGANIZATION OF STUDY

The remainder of this thesis is divided into four chapters. Chapter II is a review of current literature relevant to this study. Topics researched include (1) the mission statement and strategic plan of the United States Naval Academy, (2) the admissions policy of the United States Naval Academy, (3) the plebe summer training program at the Naval Academy, to include analysis and the goals of each phase of the Midshipman Fourth Class Indoctrination system, (4) attrition studies conducted in college and military settings, with specific emphasis on military boot-camp attrition studies, and (5) a discussion of the theory explaining multivariate logistic regression and an analysis of the variables included in the study. Chapter III is a step-by-step description of how the study was conducted and also includes a detailed description of the data set. Chapter IV presents and discusses the results obtained from the statistical analysis of the data. To conclude the study, Chapter V answers the research questions proposed in this study and provides conclusions from the data analysis conducted in Chapter IV. Additionally, policy suggestions for the Naval Academy administration and Department of Admissions, as well as recommendations for future research, are provided in Chapter V.

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II. BACKGROUND AND LITERATURE REVIEW

A. INTRODUCTION

This chapter presents a review of current literature applicable to this study. The chapter begins with a review of the mission and strategic plan of the United States Naval Academy. Since the purpose of this study is to identify predictors of plebe summer attrition with the goal of process improvement in mind, the strategic plan is reviewed to highlight institutional focus areas for possible improvement. Following the review of the strategic plan is an analysis of the Naval Academy admissions process. This analysis reviews the criteria utilized by the admissions board when considering candidates for acceptance and provides insight into those variables that should be studied as possible predictors of plebe summer attrition. The next portion reviews the guidance and literature detailing the plebe summer training program to provide a specific understanding of the environment plebes encounter during their Naval Academy indoctrination. This is followed by a review of attrition studies conducted in similar environments, with specific emphasis placed on studies of boot-camp attrition. Other relevant studies are also reviewed to include topics such as (1) first-term enlistment attrition, (2) four-year college attrition and (3) four-year attrition of females and minorities at the service academies. The review of these studies enabled the development of the research hypothesis and identified independent variables that have predicted attrition in similar training environments. Finally, a review of statistical methods was conducted to identify the type of data required for the study and the assumptions necessary to ensure accuracy.

B. THE MISSION AND STRATEGIC PLAN OF THE UNITED STATES NAVAL ACADEMY

1. Mission Statement

Education at a service academy is the first and most crucial experience of a professional soldier; and although attendance at a service academy is not universal for generals and admirals, the academies set the standards of behavior for the whole military profession.

-- Janowitz, M., The Professional Soldier

The service academies of the nation exist for reasons unique to any other academic institution of higher learning in the country. A goal of virtually every college is to educate young men and women in the hope they will one day become productive citizens and leaders. However, for the service academies this idea is much more than just a goal; it is central to their existence and to the service they provide to the nation. This is expressed for the Naval Academy in the Academy's mission statement, which is:

> To develop midshipmen morally, mentally and physically and to imbue them with the highest ideals of duty, honor and loyalty in order to provide graduates who are dedicated to a career of naval service and have potential for future development in mind and character to assume the highest responsibilities of command, citizenship and government (USNA, 2002a).

With the possible exception of their name and identification number, the mission of the Naval Academy is the very first thing all incoming midshipmen must memorize (USNA, 2003g). The mission statement provides clarity of purpose for all faculty, staff and midshipmen. It provides a sense of pride in the institution and ensures everyone involved understands the reason for the Naval Academy's existence.

2. Strategic Plan

While the mission of the Naval Academy provides a broad understanding of the goals and purpose of the institution, the strategic plan provides the vision, which is to "Provide leaders of great character, competence, vision and drive to transform the Navy and Marine Corps and serve the nation in a century of promise and uncertainty" (USNA, 2003c). Additionally, the strategic plan outlines eight focus areas academy personnel must ensure are achieved. These focus areas are (1) Leadership and Professional Excellence, (2) Physical Fitness, (3) Naval Heritage, (4) Academy Quality of Life, (5) Character Building, (6) Effective Communications (7) Admissions Excellence and (8) Academic Excellence (USNA, 2003c).

In addition to the focus areas, the strategic plan details the graduate attributes that must be instilled in each midshipman to ready them for their commission and a career of naval service. To satisfy these attributes, graduates of the Naval Academy are:

- Prepared to lead in combat
- Courageous leaders who take responsibility for their personal and professional decisions and actions

- Role Models of ethical behavior and moral conduct
- Exemplars of academic, technical and tactical competence
- Individuals with a passion and commitment to lifelong learning and physical fitness
- Highly effective communicators
- Leaders who recognize and value individual excellence regardless of gender or cultural and ethnic background
- Able to understand and integrate geopolitical complexities in their decision-making across the spectrum of military operations
- Patriots who epitomize the rich heritage, honor and traditions of the Navy, Marine Corps and our country (USNA, 2003d).

The graduate attributes presented in the strategic plan represent a daunting but not impossible achievement. The professional training programs and academic course of instruction are highly challenging, yet the Academy maintains a four-year graduation rate in excess of 77 percent (USNA, 2003e). A primary tool utilized by the Academy to achieve this high graduation rate is the strategic plan focus area of admissions excellence. By attracting, recruiting and admitting only the best qualified young men and women willing to accept the challenges of naval service, the Naval Academy ensures the high quality of its student body while providing a brigade of midshipmen that reflects the needs of the naval service (USNA, 2003f). The standards of excellence maintained by the Office of Admissions are crucial in minimizing attrition and ensuring the continued success of the Naval Academy.

C.   U.S. NAVAL ACADEMY ADMISSIONS

Understanding the Naval Academy admissions system is crucial to this study. Virtually all data analyzed in this study were originally obtained during the admissions process and the results of this study are intended to assist the Office of Admissions in the improvement of the admissions process.

1.   Objectives

Admissions excellence is one of the institutional focus areas identified in the Naval Academy's strategic plan. Additionally, it is recognized that continued excellence in this area is instrumental to the success of the Naval Academy due to the nationwide

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competition for top performing high school students (Board of Visitors, 2003). In support of this focus area and the mission of the Naval Academy, the primary objective of the Naval Academy's Admissions Process is to select candidates for admission who:

- are mentally and physically able to undertake rigorous academic, professional education as well as physical training programs
- show interest in serving their country as professional officers in the Naval Service
- show capabilities and interest in fields of study that reflect the needs of the Navy and Marine Corps
- show potential for leadership in the Naval Service
- show the capacity and desire to complete the four-year course and remain in the service beyond the period of obligated service after commissioning
- are of good moral character
- represent women and minorities in appropriate numbers in support of the Equal Opportunity Program of the Department of the Navy
- are most likely to complete the Naval Academy Program and successfully serve as officers in the U.S. Navy and Marine Corps (Black, 2001).

This set of applicant requirements makes the admissions process at the service academies uniquely different from the admissions process at civilian universities throughout the country. Applicants to the Naval Academy are much more than just potential college students; they are also prospective naval officers and must be specifically selected for that purpose.

2. Candidate Eligibility

More than 12,000 individuals are identified as applicants to the United States Naval Academy each year (USNA, 2002a). To manage the administrative burden associated with such a large applicant pool, the Naval Academy Admissions Office utilizes a three-tiered eligibility system. The purpose of the three-tiered system is to filter out non-qualified personnel from the applicant pool. Tier One, the Contact Tier, is utilized to ensure each applicant satisfies a series of basic eligibility requirements. Fulfilling these requirements earns an individual the designation of qualified applicant and Office of Admissions personnel will send all qualified applicants both a Preliminary Application and a Pre-Candidate Questionnaire (Black, 2001). The next tier is known as

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the Prospective Midshipman Tier. Office of Admissions personnel make an initial assessment of the strength of each applicant's record in determining their Tier-Two eligibility. By satisfying the eligibility requirements of Tier Two an applicant becomes an official candidate for admission to the Naval Academy and will be mailed the official Naval Academy application. The final criteria for admission to the Naval Academy are contained in Tier Three. An application is complete and will be reviewed by the Admissions Board once Tier-Three eligibility requirements are complete. The Admissions Board offers an appointment or rejection to each candidate, and accepted candidates must then decide whether or not to attend the Naval Academy. Approximately 200 to 300 candidates refuse offers of admission each year (D. Nelson, personal communication, February, 2003).

The eligibility requirements for each of the three tiers are listed below (USNA, 2002a).

Tier 1. Contact Tier – Basic Eligibility

- Prospective applicants must be United States citizens.
- Prospective applicants must be individuals of good moral character (this is measured by information obtained in the application process, including teacher recommendations and the Blue and Gold Officer interview).
- Prospective applicants must be at least 17 years of age and no older than 23 years of age on the 1st of July of the year they would enter the academy.
- Prospective applicants must not be married.
- Prospective applicants cannot be pregnant.
- Prospective applicants must have no legal obligation to support a child, children, or other individual.

Tier 2. Prospective Midshipman Tier – Intermediate Requirements

- Applicants must possess or obtain a social security number.
- Applicants must complete and submit a Preliminary Application.
- Applicants must obtain one or more nominations.
- Applicants must take the SAT or ACT college admissions test.

Tier 3. Candidate Tier – Advanced Requirements

- Candidates must complete and submit a candidate application packet.

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- Candidates must take the Department of Defense Medical Evaluation Review Board (DoDMERB).
- Candidates must take the Physical Aptitude Examination.
- Candidates must interview with a Naval Academy Information Officer in their local area.

3. Candidate Evaluation

The Naval Academy Admissions Board meets every Thursday from the end of August through April. At the initial meeting the board will discuss the profile of the incoming class desired by the Superintendent and indoctrinate new board members. The Naval Academy utilizes a rolling admissions process, which means applications will be reviewed as they are received. As cited in Black (2001), the Superintendent provides guidance to the Admissions Board that one of the goals of the admissions process is to have all applicants receive notification of appointment or rejection no later than 15 April of the induction year.

Candidate applications are primarily evaluated using a metric known as the Whole Person Multiple (WPM). The WPM is calculated from information contained in the candidate's application for admission and provides the board with a tool to objectively evaluate and compare the attributes of each candidate. The WPM is designed to be a predictor for successful completion of freshman year at the Naval Academy (G. Gottschalk, personal communication, June, 2002). Qualifying candidate multiples fall between the ranges of 58,000 to greater than 80,000 points. The components of the WPM and their weighting factors are listed below (Black, 2001).

- Highest SAT verbal score (15 percent)
- Highest SAT math score (31 percent)
- High school class rank (21 percent)
- High school English and Math teacher recommendations (8 percent)
- Extra Curricular Activity and athletic participation (10 percent)
- Strong Interest Inventory Technical Interest Score (12 percent)
- Strong Interest Inventory Career Interest Score (3 percent)

When the Admissions Board reviews an application, the computer-generated WPM is not necessarily the multiple they assign to the candidate. As instructed by the

Superintendent of the Naval Academy, the Admissions Board has the ability to modify a candidates' WPM by anywhere from -500 to +9,000 points based on the board's view that the calculated WPM does not "accurately reflect their potential and motivation to succeed in a career in the Naval Service" (Black, 2001, pg. 7-9). These additional points are referred to as Recommendations of the Admissions Board (RAB) and are awarded to approximately 75 to 85 percent of each incoming class (D. Nelson, personal communication, February, 2003). Awarding of RAB points to the WPM is a crucial segment of the admissions process, as it enables the Admissions Board to select candidates who better fulfill the applicant requirements defined above.

D.   FOURTH CLASS INDOCTRINATION (PLEBE SUMMER) PROGRAM

Regardless of any prior military or academic instruction received in their past, all midshipmen participate in the Fourth Class Development System during their entire freshman (plebe) year. The Fourth Class Development System has two distinct phases. The first phase is conducted during plebe summer and encompasses indoctrination into the naval service. Phase two is the training phase and is conducted during the academic year (USNA, 2003g). The two phases of the Fourth Class Development System are complementary and the successful completion will effect the successful transition from civilian to military life. This portion of the study reviews the purpose and objectives of the Fourth Class Indoctrination System (plebe summer) as outlined in Naval Academy instructions.

Plebe summer serves as the introduction to both the naval service and the Naval Academy to the large majority of incoming plebes. While approximately 20 percent of incoming midshipmen have enlisted experience from either the fleet or the Naval Academy Preparatory School, the bulk of the class arrives in Annapolis directly from high school and plebe summer will be their first extended period away from home (Nelson, 2002). Plebe summer begins each year with Induction Day and lasts approximately seven weeks until its conclusion with the reform of the Brigade from summer training and the commencement of the academic year (USNA, 2002b). Plebe summer encompasses a demanding training environment designed to produce midshipmen who function effectively within the Brigade, are trained in drill, are physically fit and practice the professional and personal traits, which distinguish them as

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midshipmen of the United States Naval Academy (USNA, 2003g). The specific objectives of plebe summer are:

- transition from civilian or enlisted to officer candidate (naval midshipman) status
- indoctrinate and train midshipmen in proper military discipline, military courtesies, requirements and traits of special trust and confidence, teamwork, Navy core values, and personal accountability
- provide basic training in seamanship, marksmanship, military drill, watch standing, and customs and traditions of the Naval service
- instill the importance of physical training and well being in order to meet the highest standards of readiness (USNA, 2003g).

To pursue the defined objectives, plebe summer is comprised of three phases (USNA, 2003g). The first phase is the Processing Phase, which is administrative in nature and encompasses such tasks as equipment issue, paperwork, introductory lectures and academic placement testing (USNA, 2003g). The Forming Phase is the second phase of plebe summer. The primary objective of the Forming Phase is a concentrated basic military indoctrination. This phase involves a high-stress environment designed to instill discipline and develop teamwork amongst the Fourth Class Midshipmen (USNA, 2003g). The final, and longest, phase of plebe summer is the Training Phase. The primary objective of the Training Phase is continued progressive development through demanding training and follow-up to ensure the incoming class meets the personal and professional standards expected of midshipmen at the Naval Academy (USNA, 2003g). Following completion of all three phases midshipmen are expected to satisfy the following training objectives:

- know all basic professional knowledge requirements
- properly wear all uniforms
- provide directions to any significant location on campus
- be qualified in small sailing craft and small arms
- be qualified to properly stand military watches to include Company Mate of the Deck and Main Office Messenger
- demonstrate a working knowledge of Midshipman Regulations
- achieve at least a grade of "C" on the Physical Readiness Test (USNA, 2003g).

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As discussed above, plebe summer is the indoctrination phase of the Fourth Class Development System. Attrition is not one of the objectives of plebe summer, and although procedures exist to allow for the immediate discharge of unsatisfactory performers, they are seldom used (USNA, 2001). Instead, plebes who display poor performance receive counseling and guidance to aid in their successful completion of plebe summer and advance them to the academic year portion of the Fourth Class Development System. Virtually all personnel losses occurring during plebe summer are the result of voluntary resignation (D. Nelson, personal communication, February, 2003).

The first portion of this chapter provided an introduction to areas of the United States Naval Academy vital to this study. A broad review of the mission and strategic plan was conducted, followed by a detailed review of the Naval Academy admissions process and the plebe summer training program. The remainder of this chapter is devoted to the review and analysis of various attrition and retention studies relevant to this thesis.

E. ATTRITION STUDIES IN RELATED ENVIRONMENTS

1. Introduction

Attrition is a topic that has been studied at great length in various forums throughout the world. Attrition is typically associated with negative connotations. With regards to industry, attrition from employee training programs results in lost money training prospective employees. In academic institutions, higher than expected attrition reduces the number of students able to enroll in higher-level courses and also reduces the number of potential graduates. Conversely, lower-than-expected attrition can result in too many students, crowded classrooms and not enough dormitory space. By studying attrition, one can gain an understanding of the factors contributing to attrition. While it will never be possible (or desirable) to eliminate attrition entirely, this knowledge can be applied to manage attrition and improve the Naval Academy process. This portion of the study analyzes previous attrition studies covering military boot-camp environments, first-term enlistment attrition, attrition from four-year colleges and universities and four-year attrition at the United States Naval Academy. Research in these fields is scarce, and in some cases greater than ten years old; however, the existing studies are relatively consistent with one another in identifying variables for this study.

2. Boot-Camp Attrition

Studies of boot-camp attrition primarily focus on the physical demands of the training environment and the qualities one must possess to successfully complete the training regimen. This is in part because the services themselves report most recruits who fail to complete basic training do so for physical reasons, including injuries, previously undisclosed conditions and other performance-related issues (Gilmore, 2001).

In his study specifically focusing on weight problems and their relation to the attrition of high-quality military recruits, Buddin found that many medically-overweight enlistees are high attrition risks, particularly during basic training (Buddin, 1989). Specifically, Buddin found that overweight men have attrition rates several percentage points above average in the Navy and Air Force, while in the Army and Marine Corps they experienced attrition rates two to three times greater than those of average-weight recruits (Buddin, 1989). However, when Buddin applied the same model to females he found that weight differences among women enlistees had little effect on their attrition rates (Buddin, 1989).

Why did this study show that weight differences among men had a significant effect on boot-camp attrition when weight differences among women did not? The answer lies how one defines an enlistee as being overweight. Using the standards established by the medical community, approximately 14 percent of 17- to 22-year-olds (both male and female) are overweight (Buddin, 1989). However, the military does not use the standards established by the medical community when determining enlistment eligibility. By military enlistment standards, only four percent of 17- to 22-year-old males are classified as overweight (Buddin, 1989). While the military standard for men is relaxed when compared to the standard of the medical community, the military standard for women is significantly more stringent. Almost 20 percent of 17- to 22-year-old females are classified overweight by military enlistment standards (Buddin, 1989). The result of this difference in standards is that less than one percent of female enlistees are overweight by medical community standards while approximately 13 percent of male enlistees exceed the medical community standard for being overweight by greater than ten pounds (Buddin, 1989).

A second study, conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences addressed attrition from the Army's Delayed Entry Program through the boot camp phase of training. This study identified independent variables of interest based on their historical, sociological, or policy interest (Fischl and Blackwell, 2000). One variable analyzed was performance on the Armed Forces Qualifications Test (AFQT). The AFQT is designed to measure the trainability of potential recruits and identify individuals who are at high risk of not completing the initial training program. Table 1 summarizes the AFQT score categories (Kilburn, Hanser and Klerman, 1998).

Table 1.   AFQT Percentiles and Categories

AFQT Percentile	AFQT Category
93-99	I
65-92	II
50-64	III-A
31-49	III-B
10-30	IV
1-9	V

Historically, the Army has been most interested in selecting applicants scoring in the top half of the score distribution (Categories I-IIIA) of this standardized test. Additionally, Congress mandates that no enlistees may come from Category V and no more than 25 percent of enlistees can come from Category IV (Kilburn, Hanser and Klerman, 1998). By analyzing AFQT performance as a predictor of attrition, this study confirmed the desirability of enlisting those individuals that scored in the top three categories as well as the undesirability of enlisting individuals that scored in the lower two categories (Fischl and Blackwell, 2000). This study also analyzed the effect of being overweight on attrition. Similar to the findings of Buddin (1989), Fischl and Blackwell determined the heaviest five percent of both males and females were poor attrition risks, exhibiting attrition rates several points higher than their peers in the boot camp model (Fischl and Blackwell, 2000).

3.   First-Term Enlistment Attrition

In addition to the studies that have been conducted analyzing boot camp attrition, several studies have also been completed analyzing first-term enlistment attrition. These studies are important to the services because it has been found that more than fourteen percent of new recruits leave the service during the first six months, and more than 30 percent leave before the end of their first enlistment term (Gebicke, 1997). These studies are relevant to this thesis because first-term attrition includes the boot camp period and the models used to conduct these studies are similar to the model used in this thesis.

Richard Buddin, who conducted the 1989 study on boot camp attrition referenced above, also conducted a 1984 study that analyzed early military attrition behavior. Using a multivariate logistic regression model, Buddin determined the following to be significant predictors of first-term attrition: (1) high school grades and education level, (2) the enlistee's age at induction, (3) whether the person was white or non-white and (4) performance on standardized test scores (Buddin, 1984). Specifically, Buddin found that (1) non-high school graduates have attrition rates eight percentage points higher than those of high school graduates; (2) attrition increased approximately one percentage point per year for each year beyond age 17; (3) blacks and Hispanics have lower attrition rates than white non-Hispanics; and (4) individuals with AFQT scores in the lower categories (Category III-B and Category IV) have higher attrition rates (Buddin, 1984).

In a more recent technical report commissioned by the Office of the Deputy Chief of Staff for Personnel, Buttrey and Larson (1999) analyzed whether variables such as gender, race, education level and AFQT performance could be utilized to predict attrition in the army. Their study revealed that gender in combination with race provides the most accurate prediction of attrition rates from the army. Specifically, they found white females exhibited the highest first-term attrition rates and minority men exhibited the lowest first-term attrition rates. The attrition rates of white men and minority women were found to be approximately equal. In addition to race/gender combinations, this study also identified AFQT performance and level of education prior to enlistment as significant predictors of first-term attrition. With regards to these variables, AFQT scores in Category III-B and below and failure to obtain a high-school diploma both yielded

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higher first-term attrition rates, with AFQT performance having a more dominant effect (Buttrey and Larson, 1999).

In a similar study conducted as a master's thesis, Elis (1999) utilized a multivariate logit model to analyze first-term attrition for all four branches of the service. Elis' findings were consistent with those of Buttrey and Larson (1999) in that he also found gender, race, education level and AFQT scores to be significant predictors of attrition. Regarding education level, Elis found that high school dropouts and enlistees with a GED are 19.5 percent more likely to attrite than high school graduates (Elis, 1999). Additionally, he found that as an enlistee's AFQT percentile rises, the probability of attrition decreases by the marginal effect of 0.0015 percentage points multiplied by the change in AFQT score. His study also provided findings consistent with those of Buddin (1984) and Buttrey and Larson (1999) with regards to race/gender combinations, as white women were once again found to display the highest attrition rates and minority men were found to display the lowest attrition rates in all services (Elis, 1999).

4. Four-year College Attrition

Although plebe summer at the Naval Academy is very similar in nature to a boot camp training environment, attrition studies from colleges and universities are also relevant since the sample composition is similar to that found in a Naval Academy cohort. Early work done by Astin reported numerous studies (A. W. Astin, 1971, 1972; H. S. Astin, 1970; Astin and Panos, 1969; Cope, 1969; DeVecchio, 1972; Newman, 1965; Summerskill, 1962; Trent and Medsker, 1967) have been conducted with the intent of identifying which personal characteristics predict dropping out of college. These studies suggest a number of background characteristics may be predictive: ability, secondary school grades, socioeconomic status, educational aspirations and personal expectations (Astin, 1975). Using Astin's work as a foundation, Tinto (1993) developed one of the more notable models of student persistence/withdrawal behavior from postsecondary institutions. Tinto developed a longitudinal, explanatory model of the persistence/withdrawal process based on the degree of fit between the student and the institutional environment. Tinto found that stronger levels of social and academic integration led to greater subsequent levels of commitment to the institution and the goal of graduation, hence greater persistence. Drawing from Tinto's models of integration,

one can identify variables such as gender, race, parent's military service, recruited athlete status and summer seminar attendance, which might influence integration into the social environment at the Naval Academy.

Although the first edition of Tinto's book was not published until 1987, several journal articles detailing his model were published as early as 1975. These early forms of Tinto's longitudinal model were used as the basis for a subsequent study conducted by Pascarella, Terenzini and Wolfle (1986). This study sought to test the influence of a two-day orientation program on voluntary freshman year persistence/withdrawal decisions. The results of the study indicate a two-day orientation program had a small direct effect on persistence (Pascarella, Terenzini and Wolfle, 1986). However, the two-day orientation program had a dramatic effect on improving the level of social integration experienced by the students who attended the orientation sessions. This resulted in a rather large indirect effect on persistence due to the higher level of institutional commitment that resulted from the higher levels of social integration (Pascarella, Terenzini and Wolfle, 1986).

5. Four-year Service Academy Attrition

Studies have been conducted concerning four-year attrition from the service academies. Although they expand the focus beyond the eight weeks of plebe summer, they are useful to this study because they identify possible causes of attrition from the institution. One such study performed by Mitchell (1999) analyzed voluntary resignation of female midshipmen from the Naval Academy. Mitchell analyzed the Naval Academy classes of 1992-1997 and discovered that women left at a rate of 29.0 percent as opposed to the 19.9 percent attrition rate exhibited by males. Mitchell went on to determine the utility of the Meyers-Briggs Type Indicator (MBTI) in predicting the attrition probability of females at the Naval Academy. However, the focus of this study is limited to those variables available prior to Induction Day, and a midshipman's MBTI personality type is not determined until this date. Therefore, the significance of Mitchell's research to this study is the identification of gender as a variable predictive of Naval Academy attrition.

While Mitchell's study specifically examined the role played by gender in Naval Academy attrition, other studies have examined the role played by race. One such study was conducted by Roush, who analyzed the impact of minority versus majority status on

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early attrition from the Naval Academy. He discovered that while minorities (who made up 16.3 percent of the sample) accounted for 20 percent of the resignations, the difference was not statistically significant (Roush, 1989).

Expanding on the work of Roush, another valuable study was performed by O'Conner (1993), however this study was conducted at the United States Coast Guard Academy (USCGA). The USCGA and the Naval Academy have similar four-class systems as well as similar military, academic and physical requirements. O'Conner used the model developed by Roush to examine a random sampling of 100 USCGA cadets. Although the O'Conner study is limited because it did not analyze gender status, it did provide support to the theory that minority status is predictive of higher attrition rates from the USCGA (O'Conner, 1993). O'Conner also found that academic success leads to greater persistence, suggesting that cadets who are less likely to succeed academically will be more likely to resign (O'Conner, 1993). While the models used in the aforementioned studies differ from the models used in this thesis, it is important to recognize these studies suggest race, gender and aptitude all play a significant role in predicting attrition.

F.   METHODOLOGY

The method of statistical analysis used in this study is non-linear regression analysis of a dichotomous dependent variable. This method is used to analyze a dichotomous dependent variable that has only two values – one implying "yes" and zero implying "no" to a decision such as plebe summer attrition that is modeled as part of a behavior process (Bowman, 1998). In this form of regression analysis there is no limit to the number of independent variables that can be used in the study (Schwab, 1999). While this analysis technique requires the dependent measure to be dichotomous, the independent variables can be interval level or categorical (Morgan, Griego & Gloeckner, 2001). Additionally, the independent variables do not need to be normally distributed, although the solution may be more stable if they are (Morgan, Griego and Gloeckner, 2001).

The data set in this study is ideally suited for non-linear regression analysis of a dichotomous dependent variable. The dependent measure in this study is whether or not a midshipman completed plebe summer. The independent variables represent a wide

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variety of entry level data collected during the admissions process and detailed in Chapter III of this study.

III. DESCRIPTION OF DATA AND RESEARCH METHODOLOGY

A. INTRODUCTION

The purpose of this thesis is to identify variables that significantly predict whether or not a midshipmen will successfully compete plebe summer at the United States Naval Academy. Entry-level data are collected from incoming midshipmen and quantitatively analyzed to develop a model predicting plebe summer attrition. It is hoped that this model will be utilized by Naval Academy policy makers and the Admissions Office to improve the Naval Academy process.

This study began with a review of background information pertinent to plebe summer at the United States Naval Academy. Information was gathered from the Naval Academy Strategic Plan, the Office of Admissions and various personnel throughout the campus. This effort uncovered significant speculation as to what actually effects plebe summer attrition. First, Academy personnel believe the following: 1) midshipmen who attended summer seminar as high school students, and recruited athletes, both exhibit lower plebe summer attrition rates; 2) females attrite from plebe summer at a higher rate than males; 3) higher temperatures during plebe summer cause higher attrition rates; and 4) midshipmen with lower values on the WPM attrite from plebe summer at a higher rate.

Following the review of background information, a thorough literature review of attrition studies in similar environments was conducted. The literature review suggested many variables that may be predictive of plebe summer attrition. The studies conducted by Elis (1999) and Buttrey and Larson (1999) show that minority males demonstrate the lowest plebe summer attrition and majority females demonstrate the highest plebe summer attrition. Further research conducted by Buddin (1984) suggests that older midshipmen are less likely to complete plebe summer. Additionally, studies conducted by Buddin (1984), Elis (1999), Buttrey and Larson (1999) and Fischl and Blackwell (2000) all suggest midshipmen with poorer performance on standardized tests (SAT) demonstrate higher plebe summer attrition. Tinto's (1993) model of social integration suggests additional variables that may impact plebe summer attrition. Based on Tinto's assertion that higher levels of integration lead to increased persistence, it is reasonable to

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expect that midshipmen who attended the Naval Academy summer seminar, who are recruited athletes, or who have parents who graduated from a service academy or served in the military will all demonstrate lower levels of plebe summer attrition.

Although the studies by Buddin (1989) and Fischl and Blackwell (2000) suggest midshipmen who exceed the limits of the height/weight table are more likely to attrite from plebe summer, Academy speculation contradicts this. This is because many of the recruited varsity athletes exceed the limits of the height/weight table due to muscle mass, which weighs more than fat. This researcher speculates that this increased muscle mass in combination with the higher level of social integration resulting from belonging to a sports team will overcome the negative effects of exceeding the limits of the height/weight table. However, this also leads to the belief that midshipmen who exceed the limits of the height/weight table and are not recruited varsity athletes will exhibit higher plebe summer attrition.

B. RESEARCH QUESTIONS

The purpose of this study is to identify what factors actually influence plebe summer attrition at the Naval Academy. The following research questions have been developed to achieve this goal.

1. What Office of Admissions entry-level variables, such as gender, race, age, summer seminar attendance, recruited athlete status, parent's military history, SAT scores and WPM are significantly related to plebe summer attrition?

2. Is a midshipman's compliance with height and weight standards on induction day significantly related to plebe summer attrition?

3. Is the weather (temperature) significantly related to plebe summer attrition?

4. Can an empirical model be developed to identify which midshipmen are most likely to attrite during plebe summer?

C. DESCRIPTION OF DATA

All midshipmen data for this study were obtained from the Data Warehouse maintained by IR at the United States Naval Academy. This study analyzed all midshipmen who entered the Naval Academy from the summer of 1995 to the summer of

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2002 (eight cohorts). The study does not encompass data prior to 1995 because the height and weight of midshipmen on Induction Day are not included in the Data Warehouse prior to 1995. The initial data set obtained from the Data Warehouse contained a total of 9,803 cases. Table 2 provides a description of each variable obtained in the initial data set.

Data cleaning techniques were utilized as described below to resolve all discrepancies discovered in the initial data set. First, 39 cases contained only a midshipman identification number and no other data. These individuals were determined to have never entered the Academy and were deleted from the data set. Next, 77 entries were discovered to be duplicate entries and were deleted from the data set. Of these 77 cases, six were due to a name change by the individual and the remaining 71 were due to "turn backs" or "readmits" who were ultimately inducted in a future class. Nine cases were deleted due to obvious errors in either the height or weight entries (one or both values equal to zero). Finally, an additional 124 cases were deleted due to missing the height and weight data entirely. In all, 249 cases (2.5 percent) were deleted from the original data set containing 9,803 cases. This resulted in a sample size for analysis of 9,554 total midshipmen (N = 9,554). The small number of deleted cases is not expected to affect the accuracy of this study.

Once the data cleaning techniques were complete, several variables were recoded and new variables were created to arrive at the final data set used in the analysis. The following is a summary of the data manipulation performed for this thesis.

- The gender variable was recoded such that males were represented by a value of 0 and females were represented by a value of 1.
- The ethnicity variable was recoded into a new variable designed to designate majority or minority status. Midshipmen with an ethnic code of CA were assigned a value of 0 and all other ethnic codes were assigned a value of 1, signifying minority status.
- A new variable was created called minority-male (min_male). Midshipmen with a minority value of 1 and a gender value of 0 were assigned a value of 1 for this variable. All other midshipmen were assigned a value of 0.

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Table 2.   Variables Obtained from Data Warehouse

Variable	Description
Graduation Year 1999 to 2006	The year each midshipman is scheduled to graduate.
Enrollment Status 0, 30, or 40	Code signifying the current status of each individual. 0 = currently enrolled, 30 = attrite, 40 = graduate.
Gender M or F	Gender of each individual. M = Male, F = Female.
Ethnicity AF, AS, CA, FI, HI, NA, or OT	Race of each individual. AF = African American, AS = Asian American, CA = Caucasian, FI = Asian American, HI = Hispanic, NA = Native American, OT = Other.
Parent Service Academy 1 to 5	Designates whether or not a parent attended one of the five academies. 1 = USMA, 2 = USNA, 3 = USAFA, 4 = USCGA, 5 = USMMA.
Military Father A, AF, MC, N, CG	Military experience of the individual's father. A = Army, AF = Air Force, MC = Marine Corps, N = Navy, CG = Coast Guard.
Military Mother A, AF, MC, N, CG	Military experience of the individual's mother. A = Army, AF = Air Force, MC = Marine Corps, N = Navy, CG = Coast Guard.
Recruited Athlete Y or N	Designates whether or not an individual is a recruited varsity athlete.
SATM 0 to 805	Score from math section of SAT (maximum is 805 due to renorming of the SAT).
SATV 0 to 805	Score from verbal section of SAT (maximum is 805 due to renorming of the SAT).
WPM 51,651 to 84,019	Final WPM generated by the Office of Admissions.
Summer Seminar Y or N	Designates whether or not an individual attended the Naval Academy Summer Seminar.
Attrition Code	For midshipmen who separated from the Academy, specifies the reason for separation. 23 total choices, including three for plebe summer attrition, which are 1 = voluntary resignation plebe summer – motivation, 3 = voluntary resignation plebe summer – personal, 4 = voluntary resignation plebe summer – other.
Height	Height of each midshipman in inches measured on induction day.
Weight	Weight of each midshipman in pounds measured on induction day.
Date of Birth	The date each midshipman was born.
Date of Induction	The date each midshipman was inducted into the Naval Academy.

- A new variable was created called majority-female (maj_fem). Midshipmen with a minority value of 0 and a gender value of 1 were assigned a value of 1 for this variable. All other midshipmen were assigned a value of 0.

- The military father variable was recoded by assigning a value of 1 to midshipmen whose father had served in any branch of the military and a value of 0 to midshipmen whose father had never served in the military.

- The military mother variable was recoded by assigning a value of 1 to midshipmen whose mother had served in any branch of the military and a value of 0 to midshipmen whose mother had never served in the military.

- A new variable was created called military parent (milpar). A value of 1 meant one or both parents had military experience and a value of 0 meant neither parent had military experience.

- A new variable was created called plebe summer attrition (attps). Midshipmen who completed plebe summer were assigned a value of 1, and midshipmen who did not complete plebe summer were assigned a value of 0.

- A new variable was created to determine each midshipman's age on induction day. This variable was calculated by subtracting the date of birth from the induction date and is represented in units of years.

- A new variable was created to specify whether or not an individual exceeded the standards of the height/weight table on induction day. The maximum allowable weight was retrieved from the height/weight standards table based on each midshipman's height. This weight was then compared with the weight of each midshipman to determine whether or not they exceeded specifications. A value of 0 was assigned for midshipmen within specifications and a value of 1 was assigned for midshipmen who exceeded specifications. Since the height/weight table has limits of 60 to 78 inches, a small number of midshipmen (24 males, 5 females) exceeded the bounds of this table. However, the table is linear so the weight specifications were extrapolated for these midshipmen.

- A final new variable was created to signify midshipmen who exceeded the limits of the height/weight table and were not recruited varsity athletes. Individuals who exceeded the limits of the height/weight table and were not recruited athletes were

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assigned a value of 1 for this variable. All other individuals were assigned a value of 0.

The only remaining data required for the study were the temperature conditions from each summer. These values were obtained from the Internet weather service, Accuweather.com, which provided certified temperature data from Baltimore-Washington International Airport (high, low and average) for each day of plebe summer for the years in the study. The high temperature from each day was used to calculate the average high temperature for each week of plebe summer, each half of plebe summer and for the summer as a whole.

The data cleaning and recoding process resulted in a final data set containing 9,554 midshipmen (N = 9,554). Appendix A lists and describes the variables contained in the final data set used for analysis.

D. RESEARCH HYPOTHESES

The research questions in this study led to the development of the following hypotheses.

1. **What Office of Admissions entry-level variables, such as gender, race, age, summer seminar attendance, recruited athlete status, parent's military history, SAT scores and WPM significantly affect plebe summer attrition?**

$H_0 =$ There is no difference in plebe summer attrition rates as a result of differences in Office of Admissions entry-level variables such as gender, race, age, summer seminar attendance, recruited athlete status, parent's military history, SAT scores and WPM.

$H_1 =$ Females will attrite at a higher rate than the population.

$H_2 =$ Minorities will attrite at a lower rate than the population.

$H_3 =$ Minority males will attrite at a lower rate than the population.

$H_4 =$ Majority females will attrite at a higher rate than the population.

$H_5 =$ The attrition rate will increase with increases in age.

$H_6 =$ Midshipmen who attended summer seminar will attrite at a lower rate than the population.

$H_7 =$ Recruited varsity athletes will attrite at a lower rate than the population.

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$H_8 =$ Midshipmen with parents who served in the military will attrite at a lower rate than the population.

$H_9 =$ Midshipmen with parents who graduated from a service academy will attrite at a lower rate than the population.

$H_{10} =$ Midshipmen with higher SAT scores will attrite at a lower rate than the population.

$H_{11} =$ Midshipmen with higher WPMs will attrite at a lower rate than the population.

2. **Does a midshipman's ability to comply with height and weight standards on induction day have a significant effect on plebe summer attrition?**

$H_0 =$ There is no difference in plebe summer attrition rates between midshipmen who exceed the limits of the height/weight table on induction day and midshipmen who satisfy the limits.

$H_{12} =$ Midshipmen who exceed the limits of the height/weight table on induction day will attrite at a higher rate than the population.

$H_{13} =$ Midshipmen who exceed the limits of the height/weight table and are not recruited varsity athletes will attrite at a higher rate than the population.

3. **Does the weather (temperature) have a significant effect on plebe summer attrition?**

$H_0 =$ The temperature conditions are not related to the plebe summer attrition rate.

$H_{14} =$ Higher temperatures during plebe summer are related to higher plebe summer attrition.

4. **Can an empirical model be developed to identify which midshipmen are most likely to attrite during plebe summer?**

$H_0 =$ An empirical model can not be developed that will predict plebe summer attrition with statistical significance.

$H_{15} =$ An empirical model can be developed that will predict plebe summer attrition with statistical significance.

E.   METHODOLOGY

According to Bowman (1998) "Linear regression analysis is often the 'tool of choice' for social science researchers who attempt to explain the complex relationships between an observed outcome measured on a continuous scale" (pg. 2). In fact, a critical assumption for linear regression to accurately predict these relationships is a dependent variable measured on a continuous scale. In this study, the dependent variable is dichotomous. Plebe summer is either completed or it is not. Therefore, linear regression analysis is not appropriate, and a more complex, non-linear model must be used that transforms the dependent variable into the probability of an event occurring (Bowman, 1998). The model chosen for this study was binary logistic (LOGIT) regression.

As demonstrated in Bowman (1998) "It is possible to transform the dichotomous dependent variable into a new random variable that shares the properties of being unbounded and continuous so that the probability of observing the transformed values can take on values bounded by 0 and 1" (pg. 5). This allows the subsequent determination of estimators to be used for hypothesis testing. The logistic distribution function is one possible transformation. This function is denoted by

$$P_i = E[Y_i|X_i] = \frac{e^{b_0 + b_1 X_{1,i}}}{1 + e^{b_0 + b_1 X_{1,i}}}$$

where $e(=2.718)$ is the base of the natural logarithms. This equation can subsequently be rewritten as

$$P = \frac{e^{z_i}}{1 + e^{z_i}} = \frac{1}{1 + e^{-z_i}} \qquad \text{where } z_i = b_0 + b_1 X_{1,i}$$

This second form of the equation is referred to as the Probability Distribution Function. As shown in Bowman (1998), this formula satisfies the two characteristics of a probability density function. It can subsequently be shown that

$$P(Y = 0) = 1 - P(Y = 1) = 1 - P_i = \frac{1}{1 + e^{z_i}}$$

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The dependent variable can now be transformed into an "odds ratio" where

$$\frac{P_i}{1 - P_i} = \frac{\left(\dfrac{e^{Z_i}}{1 + e^{Z_i}}\right)}{\left(\dfrac{1}{1 + e^{Z_i}}\right)} = e^{Z_i} = e^{b_0 + b_1 X_{1,i}}$$

This "odds ratio" shows the ratio of the probability of success ($Y_i = 1$) to the probability of failure ($Y_i = 0$). Finally, one must take the natural log of the odds ratio. This provides the following equation

$$L_i = \ln\left(e^{b_0 + b_1 X_{1,i}}\right) = b_0 + b_1 X_{1,i}$$

The natural log of the odds ratio of $Y = 1$ provides a linear function of the independent variables, X_k, which can subsequently be analyzed using traditional linear solution methods.

To understand and utilize LOGIT regression models, three important characteristics must be understood. "First, the probability of a successful event occurring (P(Y=1)) is bounded and goes from 0 to 1, while the logit is unbounded from $-\infty$ to Z_i;" (Bowman, 1998, pg. 7). Second, although "the log likelihood ratio is linear in terms of X, the probability that Y=1 is non-linear" (Bowman, 1998, pg. 7). Therefore it is necessary to know both the estimators and the level of the probability from which the change is made. In general, the greatest change in probability occurs nearest the mean. Finally, "the slope coefficient represents the impact of a small unit change in the independent variable X on the logarithm of the odds-ratio," not the impact of a change in the independent variable on the dependent variable itself (Bowman, 1998, pg. 7). This results in estimated slope coefficients that are difficult to interpret. The slope coefficients must be converted to LOGIT marginal effects to observe the independent variables' effects on the dependent variable.

As discussed before, the statistical analysis technique used in this thesis is binary LOGIT regression of a dichotomous dependent variable. Binary regression was conducted using SPSS for windows. Once the regression analysis is complete, the LOGIT coefficients must be transformed into marginal effects slope coefficients. As outlined in Bowman (1998), four steps are required for this transformation.

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- Calculate $Z = \sum b_k * Xbar_k$

    Where: b_k = LOGIT coefficient or independent variable "k"

                $Xbar_k$ = intercept and mean values of independent variables

- Calculate $P(Y=1) = 1 / (1 + e^{-Z})$

- Calculate $P(Y=0) = 1 - P(Y=1)$

- Calculate Δ (the marginal effect)

    marginal effect = $b_k * (P * (1 - P))$.

When evaluating the results of binary LOGIT regression, it is important to remember the marginal effects of an independent variable will vary over the range of values for each of the remaining variables. It is this interdependency of non-linear models that allows them to accurately represent complex relationships and makes them suitable for this thesis.

F.   CHAPTER SUMMARY

This chapter describes the sources and methods utilized to construct the database for this thesis, to include a description and basic statistics for each variable in the study. This chapter also provides the information necessary to understand why binary LOGIT regression was chosen for this study and how it was utilized to conduct the study. Chapter IV will present the results obtained from the binary LOGIT regression analysis.

IV.   RESULTS

A.   INTRODUCTION

Four research questions were formulated to analyze predictors of plebe summer attrition at the United States Naval Academy. The starting point for this study was the null hypothesis (H_0); plebe summer attrition is not affected by changes in any multitude of independent variables. After reviewing available literature and background information, a total of fifteen alternate hypotheses were developed. Grouped by research questions, this chapter presents the results obtained from testing H_0 and each alternate hypothesis.

B.   FIRST RESEARCH QUESTION

1.   Gender

$H_1 =$ Females will attrite at a higher rate than the population. This hypothesis was tested by conducting an independent samples t-test of the gender variable. The results table for the independent samples t-test contains statistics such as mean and standard deviation. It also contains the Levene test for equality of variances. As stated in Morgan, Griego and Gloeckner (2001), the Levene test assesses the assumption that the variances of the two groups are equal. If the Levene test is significant ($p<0.05$), then the results that do not assume equal variances for both groups are used. If the Levene test is not significant, then the results that assume equal variances for both groups are used. In this study, only the applicable results for each variable are included. Additionally, SPSS for Windows (SPSS, 1999) calculates 2-tailed significance values for the independent samples t-test. Since the alternate hypotheses in this study are directional, the t-test significance value is halved to calculate the 1-tailed significance values that are included in the results table throughout this study. Table 3 provides the results of this test.

The gender variable proved to be statistically significant in predicting plebe summer attrition with $t(1937.8) = 5.321$, $p < 0.05$. The mean difference of plebe summer attrition rates between females and males was found to be 4.1 percent, with 95 percent confidence lower and upper limits of 2.6 and 5.7 percent. Therefore, H_0 is rejected and H_1 is accepted that females will attrite at a higher rate than males.

Table 3.   Gender Variable T-Test Results

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Men	7988	.95	.22	2.48E-03
	Women	1566	.91	.29	7.35E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	154.345	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
5.321	1937.767	.000	4.13E-02	7.76E-03	2.61E-02	5.65E-02

2.   Minority Status

H_2 = Minorities will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of the minority variable. Table 4 provides the results of this test. The minority variable does not significantly predict plebe summer attrition. For this test, $t(3069) = 1.155$, $p > 0.05$. Therefore, H_2 is rejected that there is no significant difference in plebe summer attrition based on minority status.

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Table 4. Minority Variable T-Test Results

	Minority Status	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Minority	1912	.95	.22	5.14E-03
	Majority	7642	.94	.24	2.72E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	5.039	.025

			t-test for Equality of Means				
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
					Lower	Upper	
1.155	3068.950	.124	6.72E-03	5.82E-03	-4.69E-03	1.81E-02	

3. Minority Males

$H_3 =$ Minority males will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of the minority male variable. Table 5 provides the results of this test.

Table 5. Minority-Male Variable T-Test Results

	Minority Males	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Minority-Male	1571	.95	.22	5.48E-03
	Other	7983	.94	.24	2.67E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	11.390	.001

			t-test for Equality of Means				
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
					Lower	Upper	
1.780	2375.943	.038	1.09E-02	6.10E-03	-1.10E-03	2.28E-02	

The minority male variable proved to be statistically significant in predicting plebe summer attrition with $t(2375.9) = 1.78$, $p < 0.05$. The mean difference of plebe summer attrition rates between minority males and the rest of the population was found to be 1.1 percent, with 95 percent confidence lower and upper limits of -0.1 and 2.3 percent. Therefore, H_0 is rejected and H_3 is accepted that minority males will attrite at a lower rate than other race/gender combinations.

4. Majority Females

$H_4 =$ Majority females will attrite at a higher rate than the population. This hypothesis was tested by conducting an independent samples t-test of the majority female variable. Table 6 provides the results of this test.

Table 6. Majority-Female Variable T-Test Results

	Majority Females	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Other	8329	.95	.22	2.45E-03
	Majority-Female	1225	.90	.30	8.56E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	159.831	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
5.266	1431.118	**.000**	4.69E-02	8.90E-03	2.94E-02	6.43E-02

The majority female variable proved to be statistically significant in predicting plebe summer attrition with $t(1431.1) = 5.266$, $p < 0.05$. The mean difference of plebe summer attrition rates between majority females and others was found to be 4.7 percent, with 95 percent confidence lower and upper limits of 2.9 and 6.4 percent. Therefore, H_0 is rejected and H_4 is accepted that the attrition rate exhibited by majority females will exceed the attrition rate of the population.

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5. Age

$H_5 =$ The attrition rate will increase with increases in age. This hypothesis was tested using linear regression analysis. The results of this analysis are provided in Tables 7 and 8.

Table 7.   Age Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.063[a]	.004	.004	.23

a Predictors: (Constant), Age at Induction in Years

Table 8.   Age Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	sig.
	B	Std. Error	Beta		
(Constant)	.656	.046		14.279	.000
Age at Induction in Years	1.520E-02	.002	.063	6.207	.000

a Dependent Variable: Completed Plebe Summer

The r^2 for the age variable is very low ($r^2 = 0.004$), which means the age variable accounts for very little of the variation in plebe summer attrition rates. However, the variation is statistically significant, with $t = 6.207$, $p < 0.05$. One surprising piece of information is the sign of the coefficient for the age variable. For H_5 to be valid, the sign of the coefficient must be negative. In this case the sign is positive, which indicates that as age increased, the probability of dropping out during plebe summer decreased. Figure 1 illustrates this effect. Therefore, H_5 is rejected that there is no significant increase in plebe summer attrition rates associated with increases in age.

Figure 1.   Plebe Summer Attrition Rate vs. Age
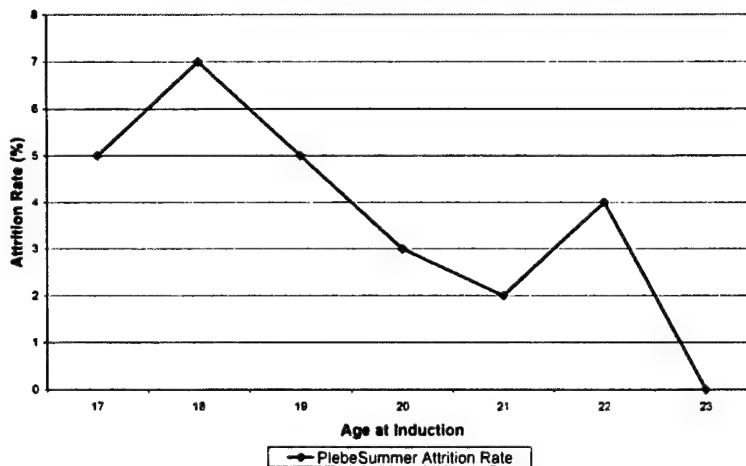
17, N = 78
18, N = 4,596
19, N = 3,423
20, N = 861
21, N = 334
22, N = 216
23, N = 46

6.   Summer Seminar

H_6 =   Midshipmen who attended summer seminar will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of the summer seminar variable. Table 9 provides the results of this test.

Table 9.   Summer Seminar Variable T-Test Results

	Summer Seminar	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Yes	2898	.95	.22	4.05E-03
	No	6656	.94	.24	2.97E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	23.018	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2.483	6078.498	.007	1.25E-02	5.02E-03	2.62E-03	2.23E-02

The summer seminar variable proved to be statistically significant in predicting plebe summer attrition with $t(6078.5) = 2.483$, $p < 0.05$. The mean difference of plebe

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summer attrition rates between midshipmen who attended summer seminar and those who did not was found to be 1.3 percent, with 95 percent confidence lower and upper limits of 0.3 and 2.2 percent. Therefore, H_0 is rejected and H_6 is accepted that midshipmen who attended summer seminar as high school students are more likely to complete plebe summer.

7. Recruited Varsity Athletes

$H_7 =$ Recruited varsity athletes will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of the recruited athlete variable. Table 10 provides the results of this test.

Table 10. Recruited Athlete Variable T-Test Results

	Recruited Athlete	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Yes	2776	.95	.21	4.04E-03
	No	6778	.94	.24	2.96E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	36.004	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
3.144	5858.077	**.001**	1.57E-02	5.01E-03	5.93E-03	2.56E-02

The recruited varsity athlete variable proved to be statistically significant in predicting plebe summer attrition with $t(5858.1) = 3.144$, $p < 0.05$. The mean difference of plebe summer attrition rates between midshipmen who were recruited varsity athletes and those who were not was found to be 1.6 percent, with 95 percent confidence lower and upper limits of 0.6 and 2.6 percent. Therefore, H_0 is rejected and H_7 is accepted that midshipmen who are recruited athletes will be more likely to complete plebe summer.

8. Military Parents

H_8 = Midshipmen with parents who served in the military will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of three separate variables. The variables tested were military father, military mother and military parent. The results of these three tests are provided in Tables 11, 12 and 13, respectively.

Table 11.   Military Father Variable T-Test Results

	Military Father	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Yes	3675	.95	.22	3.70E-03
	No	5879	.94	.24	3.15E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	13.922	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
1.892	8233.744	.029	9.19E-03	4.86E-03	-3.30E-04	1.87E-02

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Table 12. Military Mother Variable T-Test Results

	Military Mother	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Yes	395	.93	.25	1.25E-02
	No	9159	.94	.23	2.45E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances assumed	1.482	.224

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
-.613	9552	.270	-7.41E-03	1.21E-02	-3.11E-02	1.63E-02

Table 13. Military Parent Variable T-Test Results

	Military Parents	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Yes	3788	.95	.23	3.69E-03
	No	5766	.94	.24	3.16E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	7.563	.006

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
1.388	8405.512	.083	6.75E-03	4.86E-03	-2.78E-03	1.63E-02

The military father variable proved to be statistically significant in predicting plebe summer attrition with $t(8233.7) = 1.892$, $p < 0.05$. The mean difference of plebe summer attrition rates between midshipmen with fathers with military experience and

midshipmen whose fathers do not have military experience was found to be 0.9 percent, with 95 percent confidence lower and upper limits of -0.03 and 1.9 percent. The military mother and military parent variables were not found to significantly predict plebe summer attrition. The t statistics are as follows. Military mother, $t(9552) = -0.613$, $p > 0.05$. Military parent, $t(8405.5) = 1.388$, $p > 0.05$. Since the military father variable predicts plebe summer attrition with statistical significance, H_0 is rejected and H_8 is accepted that midshipmen with fathers with military experience are more likely to complete plebe summer.

9. Service Academy Parents

$H_9 =$ Midshipmen with parents who graduated from a service academy will attrite at a lower rate than the population. This hypothesis was tested by conducting an independent samples t-test of the parent service academy variable. Table 14 provides the results of this test.

Table 14.   Service Academy Parent Variable T-Test Results

	Parent Attend any Service Academy	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	One or both parents attended service academy	447	.97	.18	8.53E-03
	Neither Parent attend service academy	9107	.94	.24	2.49E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	22.726	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2.972	524.969	.002	2.64E-02	8.88E-03	8.95E-03	4.38E-02

The parent service academy variable proved to be statistically significant in predicting plebe summer attrition with $t(525.0) = 2.972$, $p < 0.05$. The mean difference of plebe summer attrition rates between midshipmen with one or both parents being service academy graduates and midshipmen without a parent that graduated from a service academy was found to be 2.6 percent, with 95 percent confidence lower and upper limits of 0.9 and 4.4 percent. Therefore, H_0 is rejected and H_9 is accepted that midshipman with one or both parents being a service academy graduate are more likely to complete plebe summer.

10.   SAT Scores

$H_{10} =$ Midshipmen with higher SAT scores will attrite at a lower rate than the population. This hypothesis was tested by performing linear regression analysis on the SAT-Math and SAT-Verbal variables. The results for the SAT-Math variable are provided in Tables 15 and 16. The results for the SAT-Verbal variable are provided in Tables 17 and 18.

Table 15.   SAT-Math Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.015[a]	.000	.000	.24

a Predictors: (Constant), SAT-Math

Table 16.   SAT-Math Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	sig.
(Constant)	.979	.025		38.689	.000
SAT-Math	-5.683E-05	.000	-.015	-1.493	.135

a Dependent Variable: Completed Plebe Summer

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Table 17.   SAT-Verbal Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.031[a]	.001	.001	.24

a Predictors: (Constant), SAT-Verbal

Table 18.   SAT-Verbal Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	sig.
(Constant)	1.011	.023		43.567	.000
SAT-Verbal	-1.100E-04	.000	-.031	-3.034	.002

a Dependent Variable: Completed Plebe Summer

The r^2 value for both regression models is very low ($r^2 < 0.001$ for SAT-Math, $r^2 = 0.001$ for SAT-Verbal). This means that neither variable accounts for virtually any variation in the plebe summer attrition rate. Additionally, for SAT-Math, $t = -1.493$, $p = 0.135$, and for SAT-Verbal, $t = -3.034$, $p = 0.002$. Since $p > 0.05$ for SAT-Math, the SAT-Math variable is not a significant predictor of plebe summer attrition. For the SAT-Verbal variable, $p < 0.05$, which means that even though this variable accounts for very little variation in the model it is does significantly predict plebe summer attrition. However, due to the sign of the coefficient and contrary to H_{10}, higher SAT-Verbal scores are predictive of higher plebe summer attrition rates. Therefore, H_{10} is rejected that changes in a midshipman's SAT scores will have no significant effect on the plebe summer attrition rate.

11.   Whole Person Multiple

H_{11} = Midshipmen with higher WPMs will attrite at a lower rate than the population. This hypothesis was tested using linear regression analysis. The results of this analysis are provided in Tables 19 and 20.

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Table 19. WPM Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.012[a]	**.000**	.000	.24

a Predictors: (Constant), Whole Person Multiple

Table 20. WPM Coefficients[a]

	Model	Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	sig.
1	(Constant)	.981	.034		28.507	.000
	WPM	-6.073E-07	.000	-.012	-1.162	.245

a Dependent Variable: Completed Plebe Summer

The r^2 for the WPM variable is very low ($r^2 < 0.001$), which means the WPM variable accounts for very little of the variation in plebe summer attrition rates. Additionally, the variation is not statistically significant, with $t = -1.162$, $p > 0.05$. Since the WPM variable does not significantly predict plebe summer attrition, H_{11} is rejected that increases in WPM cause no significant change in the plebe summer attrition rate.

C. SECOND RESEARCH QUESTION

1. Exceed Height/Weight Standards on Induction Day

$H_{12} =$ Midshipmen who exceed the limits of the height/weight table on induction day will attrite at a higher rate than the population. This hypothesis was tested by conducting an independent samples t-test of the variable stating whether or not a midshipman satisfied the standards of the height/weight table on induction day (oos_wgt). Table 21 provides the results of this test.

The out-of-spec weight on induction day variable does not significantly predict plebe summer attrition. For this test, $t(9552) = .762$, $p > 0.05$. Therefore, H_{12} is rejected that a midshipman's ability to satisfy the limits of the height/weight table on induction day does not significantly affect the attrition rate.

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Table 21. OOS_WGT Variable T-Test Results

	Out of Spec Weight at Induction	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	In Specification	8457	.94	.23	2.54E-03
	Out of Specification	1097	.94	.24	7.38E-03

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances assumed	2.302	.129

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
.762	9552	.223	5.75E-03	7.55E-03	-9.04E-03	2.05E-02

2. Exceed Height/Weight Standards and Non-Recruited Athlete

H_{13} = Midshipmen who exceed the limits of the height/weight table and are not recruited varsity athletes will attrite at a higher rate than the population. This hypothesis was tested by conducting an independent samples t-test of the variable that classified whether or not a midshipman exceeded the limits of the height/weight table and was not a recruited athlete on induction day (oos_non). Table 22 provides the results of this test.

The oos_non variable proved to be statistically significant in predicting plebe summer attrition with $t(694.8) = 2.009$, $p < 0.05$. The mean difference of plebe summer attrition rates between midshipmen in these two categories was found to be 2.2 percent, with 95 percent confidence lower and upper limits of 0.1 and 4.4 percent. Therefore, H_0 is rejected and H_{13} is accepted that midshipmen who exceed the limits of the height/weight table and induction day and are not recruited athletes are more likely to attrite during plebe summer.

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Table 22.   OOS_NON Variable T-Test Results

	Out of Spec Weight and not a Recruited Athlete	N	Mean	Std. Deviation	Std. Error Mean
Completed Plebe Summer	Other	8925	.94	.23	2.46E-03
	OOS weight, not recruited athlete	629	.92	.27	1.08E-02

		Levene's Test for Equality of Variances	
		F	Sig.
Completed Plebe Summer	Equal variances not assumed	20.163	.000

t-test for Equality of Means						
t	df	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2.009	694.761	.023	2.22E-02	1.11E-02	5.00E-04	4.40E-02

D.   THIRD RESEARCH QUESTION

1.   Plebe Summer Temperatures

H_{14} = Higher temperatures during plebe summer will cause higher plebe summer attrition rates. This hypothesis was tested by performing linear regression analysis on three variables; average temperature for the entire summer, average temperature for the first half of the summer and average temperature for the second half of the summer. The results for the entire summer variable are provided below in Tables 23 and 24. The r^2 value for the entire summer variable is very low ($r^2 < 0.001$), which means the overall average temperature of the entire summer variable accounts for very little of the variation in plebe summer attrition rates. Additionally, the variation is not statistically significant, with $t = -0.528$, $p > 0.05$. Figure 2 demonstrates this by showing the percentage of midshipmen who attrited during each summer graphed with a curve showing the average daily high temperature for each summer. Figures 3 and 4 show the same relationship with the average daily high temperature for the first and second halves of plebe summer, respectively.

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		Table 23.	Average Temp for the Entire Summer Model Summary	
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.005[a]	.000	.000	.24

a Predictors: (Constant), Overall Average Temp (F)

Table 24.   Average Temp for the Entire Summer Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.975	.065		15.113	.000
Overall Average Temp (F)	-3.892E-04	.001	-.005	-.528	.598

a Dependent Variable: Completed Plebe Summer

Figure 2.   Attrition Percentage and Entire Summer Average Temp
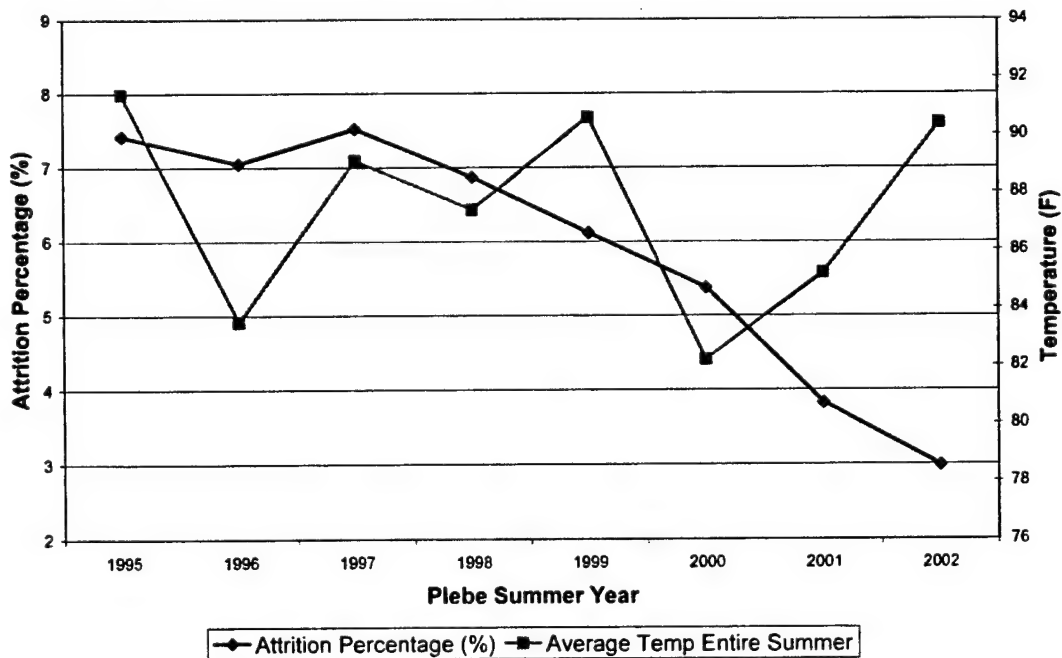
The results of the linear regression analysis for the first-half of the summer variable are provided below in Tables 25 and 26.

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Table 25.   Average Temp for First Half of Summer Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.027[a]	**.001**	.001	.24

a Predictors: (Constant), First-Half Temp (F)

Table 26.   Average Temp for First Half of Summer Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.136	.073		15.643	.000
First-Half Temp (F)	**-2.213E-03**	.001	**-.027**	**-2.681**	**.007**

a Dependent Variable: Completed Plebe Summer

The r^2 value for first-half of plebe summer temperature variable is very low ($r^2 =$ 0.001). This means that variations in temperature during the first half of plebe summer account for a very small amount of the variations observed in the plebe summer attrition rate. However, $t = -2.681$, $p < 0.05$, which means the average temperature for the first half of plebe summer is a significant predictor of plebe summer attrition. Additionally, the sign of the Beta coefficient is such that higher temperatures during the first half of plebe summer are predictive of higher plebe summer attrition rates. This relationship is demonstrated in Figure 3.

Figure 3.   Attrition Percentage and Average Temp First Half of Summer

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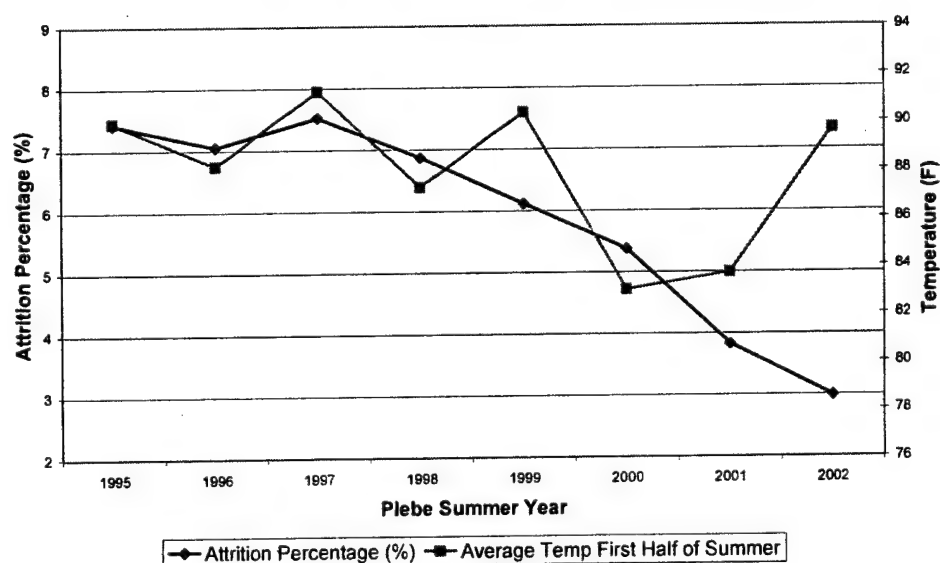
Although the most recent summer exhibited a departure from the trend of the previous seven years, the average temperature for the first half of the summer does significantly predict attrition for the duration of this study.

The results of the linear regression analysis for the second-half of plebe summer variable are provided below in Tables 27 and 28.

Table 27.   Average Temp for Second Half of Summer Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.001[a]	.000	.000	.24

a Predictors: (Constant), Second-Half Temp (F)

Table 28.   Average Temp for Second Half of Summer Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.935	.064		14.624	.000
Second-Half Temp (F)	-6.776E-05	.001	.001	.092	.926

a Dependent Variable: Completed Plebe Summer

The r^2 value for the second-half variable is very low ($r^2 < 0.001$), which means the average temperature of the second half of the summer accounts for very little of the variation in plebe summer attrition rates. Additionally, this variation is not statistically significant, with t = 0.092, p > 0.05. This is shown in Figure 4.

Figure 4.   Attrition Percentage and Average Temp Second Half of Summer

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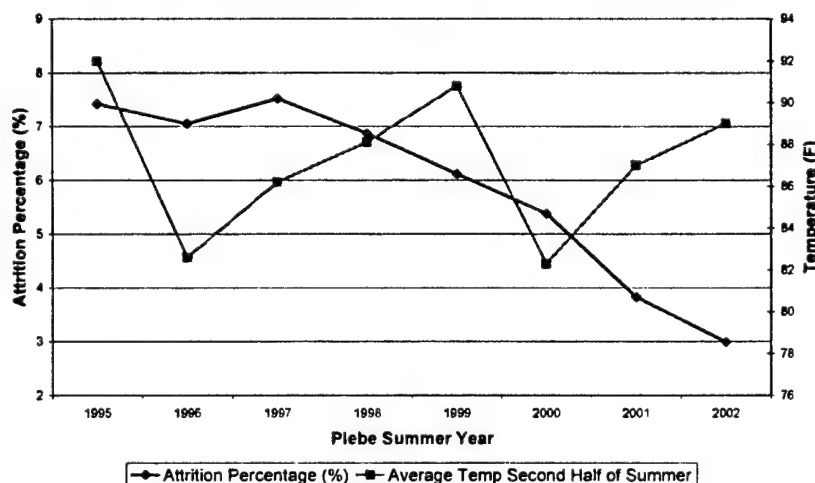
H_{14} hypothesized that increases in the temperature would lead to increases in the number of plebe summer attritions. This hypothesis holds true for the first half of plebe summer average temperature variable. Therefore, H_0 is rejected and H_{14} is accepted such that higher average temperatures during the first half of plebe summer will lead to higher plebe summer attrition rates.

E. FOURTH RESEARCH QUESTION

H_{15} = An empirical model can be developed that will predict plebe summer attrition with statistical significance. This hypothesis was tested by conducting LOGIT analysis and computing marginal effects as discussed in Chapter III of this study. Numerous iterations of the LOGIT calculation were conducted using many of the independent variables contained in this study. Table 29 shown below contains the results of the LOGIT regression and the marginal effects for the most accurate model identified.

Table 29.   Plebe Summer Attrition LOGIT Regression Model

Independent Variables	LOGIT	Significance	Marginal Effect
Constant	-1.947	.353	-.080
MAJ_FEM	**-0.649**	**.000**	**-.027**
MIN_MALE	0.150	.264	0.006
SUM_SEM	**0.404**	**.000**	**0.017**
ATHLETE	**0.442**	**.000**	**0.018**
OOS_NON	-0.288	.070	-0.012
PAR_ACAD	**0.650**	**.015**	**0.027**
SAT-V	-0.001	.079	-0.00004
WPM	**2.5E-5**	**.036**	**1.0E-6**
AGE	**0.369**	**.000**	**0.015**
HALF_1T	**-0.035**	**.027**	**-0.001**

*- Bold indicates significant

The LOGIT calculation reveals that a total of seven independent variables are statistically significant ($p < 0.05$) in this model. Six of these variables represent entry-level data available to the Office of Admissions prior to voting whether to accept or reject an application for admission. In addition to these six variables, the average daily high temperature for the first half of plebe summer is also statistically significant. The marginal effects calculated provide information regarding the relative strength of each variable in the model. For example, if a midshipman is a majority female, that person is nearly 3 percent more likely to attrite during plebe summer than a midshipman from a

different ethnic or gender group who is equal in every other way. Summer seminar attendees and recruited athletes are both almost 2 percent more likely to complete plebe summer than a similarly qualified midshipman lacking either of those attributes. Again, contrary to the research conducted by Buddin (1984) concerning first-term enlistment attrition, older midshipmen are more likely to complete plebe summer, with their chances improving 1.5 percent for every year they are older than a similarly qualified younger midshipman. The strongest predictor of plebe summer completion in this model is having a parent who graduated from service academy. Midshipmen in this category are nearly 3 percent more likely than similarly qualified peers to complete plebe summer. Finally, the WPM and average temperature for the first half of plebe summer were found to be significant in this model, although their respective marginal effects are so small that their effect is relatively negligible.

The next step in reporting the results of this portion of the study is to analyze the overall accuracy and classification ability of the model, which up to this point has been neglected. According to Bowman (1998), "measuring the goodness of fit of non-linear models is rather illusive. It remains difficult to agree on a single statistic that best measures errors from actual outcomes that have only two values – and each of these values are at the very extremes of the transformed probabilities of an event occurring" (pg. 26). As suggested in Bowman (1998) this study focuses on the Chi-Square Statistic and Classification Table provided by SPSS for Windows (SPSS, 1999). Tables 30-32 below summarize these results.

Table 30.   Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	129.379	10	.000
	Block	129.379	10	.000
	Model	**129.379**	10	**.000**

Table 31.   Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	4139.878	.013	.037

Table 32.   Classification Table

| | | | Predicted Completed Plebe Summer | | Percentage Correct |
			No	Yes	
	Observed				
Step 1	Completed Plebe	No	326	235	58.1
	Summer	Yes	3466	5527	61.5
	Overall				**61.3**
	Percentage				

a The cut value is .94

The Chi-Square = 129.379, $p < 0.05$ demonstrates that the independent variables when taken together in this model predict plebe summer attrition with statistical significance ($p < 0.05$). Additionally, this model correctly classified each midshipman in the sample 61.3 percent of the time. The classification analysis is conducted using a cutoff value = 0.94, which is the mean value for completing plebe summer for the midshipmen in the study. All midshipmen with predicted values greater than 0.94 are classified as positive, and all midshipmen with predicted values less than 0.94 are classified as negative. This model correctly predicts midshipmen who will not complete plebe summer 58.1 percent of the time and midshipmen who will complete plebe summer 61.5 percent of the time, for an overall success rate of 61.3 percent.

Since a statistically significant model was developed, H_0 is rejected and H_{15} is accepted that an empirical model can be developed which predicts plebe summer attrition with statistical significance.

F.   SUMMARY OF RESULTS

This thesis identified several variables that when taken alone or in combination are statistically significant predictors of plebe summer attrition. In support of the thesis completed by Mitchell (1999), females in general were found to be more likely to attrite during plebe summer. Additionally, in agreement with the research conducted by Elis (1999) and Buttrey and Larson (1999) majority females specifically were found to be the most vulnerable and minority males were found to be the least vulnerable to plebe summer attrition. However, not all of the findings are in agreement with past research. Contrary to the research conducted by Buddin (1984), older midshipmen were more likely than younger midshipmen to complete plebe summer and minority status taken separate from gender was found to have no significant effect on plebe summer attrition.

In his longitudinal model of student persistence/withdrawal decisions, Tinto (1993) proposed that traits that increase the social integration of an individual make them less likely to attrite. In agreement with Tinto (1993), midshipmen who either attended summer seminar or were recruited athletes were more likely to complete plebe summer. Additionally, midshipmen having one or both parents as a service academy graduate and midshipmen having a father with military experience were both more likely to complete plebe summer. However, contrary to Tinto (1993), having a mother with military experience had no effect on plebe summer attrition.

With regards to standardized test performance, SAT-Math scores had no effect on plebe summer attrition, and while SAT-Verbal scores were statistically significant, the percentage of the variance accounted for by this variable is negligible. Contrary to the research conducted by Buddin (1989) and Fischl and Blackwell (2000), exceeding the limits of the height/weight table on induction day was not found to predict attrition unless that person was not a recruited varsity athlete. Midshipmen who were not recruited athletes and exceeded the limits of the height/weight table were more likely to attrite during plebe summer. Additionally, higher temperatures during the first half of plebe summer were statistically related to plebe summer attrition rates. However, similar to the SAT-Verbal variable, the percentage of the variance accounted for by this variable is negligible. Lastly, a model was developed in which majority female status, summer seminar attendance, recruited athlete status, parent academy graduate status, WPM, age, and first-half temperature were all significant predictors of plebe summer attrition.

V.   SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A.   SUMMARY AND CONCLUSIONS

The purpose of this thesis was to determine the causes of plebe summer attrition at the United States Naval Academy. A comprehensive literature review was conducted to identify variables linked to attrition in similar environments, and information was gathered from Academy officials to determine which variables they speculate are related to attrition. These variables were analyzed for the Naval Academy cohorts who completed their plebe summer training during the summers of 1995 to 2002 (eight cohorts). The findings of this study reveal that many variables are linked to plebe summer attrition and a model can be developed to predict this attrition that is statistically significant.

This study identified four research questions concerning the topic of plebe summer attrition at the United States Naval Academy. The answers to each question and significant results are summarized below.

1.   **What Office of Admissions entry-level variables, such as gender, race, age, summer seminar attendance, recruited athlete status, parent's military history, SAT scores and WPM are significantly related to plebe summer attrition?**

This study revealed the single greatest predictor of plebe summer attrition to be a midshipman's gender, with females being greater than 4 percent more likely than males to attrite during plebe summer. Analyzing gender in combination with race revealed that majority females were almost 5 percent more likely to attrite than the rest of the population. In contrast to the majority female group, minority males were found to be the race/gender combination with the highest plebe summer completion rate, finishing the training just over 1 percent more often than the population. These results match the findings of the first-term enlistment attrition studies conducted by Elis (1999) and Buttrey and Larson (1999). While the gender variable analyzed alone revealed significant differences in plebe summer attrition, the race variable did not. In this study, the plebe summer attrition rates for minority and majority midshipmen were not significantly different.

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Other results from this study indicate that older midshipmen are more likely than younger midshipmen to successfully complete plebe summer. Recruited varsity athletes and midshipmen who attended summer seminar as high school students were also discovered to complete plebe summer at a higher rate than the population. The military experience of a midshipman's parents was also found to impact plebe summer attrition. In fact, the single variable with the second greatest affect on the plebe summer attrition rate is having a parent who graduated from a service academy. Midshipmen who have a service academy graduate for a parent are nearly 3 percent more likely than the population to complete plebe summer. Additionally, midshipmen who have fathers with military experience were also found to be slightly more likely (< 1 percent) to complete plebe summer. These findings support Tinto's (1993) theory that increased levels of integration lead to increased persistence.

A midshipman's WPM and SAT-Math score were not found to significantly impact plebe summer attrition. The SAT-Verbal variable does predict plebe summer attrition with statistical significance. However, the variance accounted for by this variable is essentially negligible. These are positive results for current Naval Academy admissions policies, since they indicate the current minimum SAT and WPM standards for acceptance are stringent enough to ensure plebe summer success.

2.   **Is a midshipman's compliance with height and weight standards on induction day significantly related to plebe summer attrition?**

The primary result from this portion of the study is that midshipmen who exceed the limits of the height/weight table on induction day and are not recruited athletes are greater than 2 percent more likely to attrite during plebe summer than the population. This distinction between athletes and non-athletes is required because 1) almost 43 percent (468 out of 1,097) of the midshipmen in the sample who exceeded the limits of the height/weight table on induction day were recruited athletes, and 2) the inclusion of athletes in the analysis skewed the results such that overweight midshipmen initially appeared to demonstrate attrition rates equal to those of the population. These findings are in agreement with the findings of the boot-camp attrition studies conducted by Buddin (1989) and Fischl and Blackwell (2000).

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3. **Is the weather (temperature) significantly related to plebe summer attrition?**

Virtually infinite possibilities exist for how to analyze the effect of temperature conditions on plebe summer attrition. This researcher decided to analyze the effects of the average daily high temperature for the first half of plebe summer, the second half of plebe summer and the entire plebe summer. Only the average daily high temperature for the first half of plebe summer was found to impact plebe summer attrition. However, with $r^2 = .001$, the effects of this variable on plebe summer attrition are negligible. This is counter to speculation by Academy officials, who believed that higher temperatures would lead to higher plebe summer attrition rates.

4. **Can an empirical model be developed to identify which midshipmen are most likely to attrite during plebe summer?**

This thesis demonstrated that an empirical model predicting plebe summer attrition can be developed. Using LOGIT regression and calculating marginal effects, this study developed a model containing a total of seven variables that significantly predict plebe summer attrition. In this model, majority females were 3 percent more likely than equally qualified midshipmen to attrite during plebe summer and midshipmen with a service academy parent were 3 percent more likely to complete plebe summer than their equally qualified peers. Midshipmen who attended summer seminar and recruited athletes were both found to be 2 percent more likely than equally qualified peers to complete plebe summer. Additionally, as a midshipman's age increased that individual was 1.5 percent more likely per year to complete plebe summer than their peers. The average daily high temperature for the first half of plebe summer and the WPM were also found to be significant in this model, although their marginal effects are so small that their effect on attrition is essentially negligible.

B. RECOMMENDATIONS TO THE UNITED STATES NAVAL ACADEMY

One of the most promising results of this study for the Naval Academy is the lack of any statistical difference in attrition rates between majority and minority midshipmen. With regards to plebe summer completion, the Academy appears to have achieved racial equality. However, the same can not be said with regards to gender. In this study, female midshipmen were found to attrite from plebe summer at a higher rate than their

male classmates. The push for gender equality is a clear and consistent trend in this country in recent years, and with the lifting of the Combat Exclusion Clause the military is at the leading edge of this trend. An effort should be made to determine why women leave the Naval Academy at a higher rate during plebe summer and what modifications (if any) should be made to the plebe summer training program to provide women with the same opportunity as men to successfully complete plebe summer.

Admissions Excellence is one of the institutional focus areas identified in the Naval Academy's Strategic Plan. This study revealed several success stories for the Office of Admissions at the United States Naval Academy. Chief among these is the Naval Academy summer seminar program, which is administered by the Office of Admissions. Midshipmen who attended summer seminar as high school students were more likely to complete plebe summer in every model analyzed during this thesis research. The summer seminar program does an outstanding job of informing prospective midshipmen exactly what the Naval Academy is like and prepares them for what to expect during the rigorous training environment of plebe summer. With the clear benefit of reducing the plebe summer attrition rate, the Academy would benefit by expanding the summer seminar program to include even more midshipmen candidates. Additionally, the Academy should make every possible effort to advertise the summer seminar program to highly desirable midshipmen candidates.

Another success story for the Office of Admissions is the lack of effect on plebe summer attrition by SAT scores and WPM values. SAT-Math scores were not found to be predictive of plebe summer attrition, and even though the SAT-Verbal scores were found to significantly predict plebe summer attrition, its effects are essentially negligible. The WPM variable was found to be significant in the empirical model, but the marginal effects showed that its impact on attrition was negligible. The SAT and WPM results indicate the current acceptance criteria employed by the Office of Admissions are effective at screening potential candidates. Midshipmen who exceed the admission requirements for these variables have virtually an equal probability of completing plebe summer regardless of how high they score.

As stated in Chapter II of this thesis, one of the objectives for the Office of Admissions is to select those candidates for acceptance who are most likely to graduate

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(Black, 2001). This study affirms the Office of Admissions practice of awarding RAB points to the WPM for sons and daughters of service academy graduates, since these midshipmen exhibit the lowest plebe summer attrition rates. Additionally, the RAB points awarded to recruited varsity athletes are also justified by their demonstrated lower plebe summer attrition rates.

However, in spite of the clear success of the Office of Admissions, an opportunity for improvement does exist. The number of midshipmen who exceed the limits of the height/weight table on induction day and are not recruited athletes (almost seven percent of the sample) is alarming to this researcher. These midshipmen demonstrate higher plebe summer attrition rates, and this researcher speculates this is due in large part to the difficulty of completing the physical aspects of the training program when initially in poor physical condition. To gain admission to the Naval Academy, candidates must pass a physical aptitude examination, a complete medical examination and an oral interview with a Naval Academy recruiter. By recording height and weight data during the medical examination and through visual observation during the interview, ample opportunity exists to identify overweight midshipmen well before they report for plebe summer. Given the higher plebe summer attrition rates of these midshipmen, it would benefit the Office of Admissions to place more consideration on a candidate's body-fat composition during the admissions process. One possible method to accomplish this would be to assign a -500 point RAB value to the WPM of overweight candidates. One of the goals for the Office of Admissions is to ensure candidates offered appointments are able to undergo the physical training programs at the Naval Academy (Black, 2001). If overweight candidates are accepted to the Naval Academy, the Office of Admissions should make every effort possible to counsel them concerning their increased attrition risk and assign them an exercise program specifically designed to prepare them for the physical rigors of plebe summer.

The final recommendation to the United States Naval Academy is to finish the renovation of Bancroft Hall and install air conditioning into the midshipmen living spaces. The plebe summer training regimen is strict and disciplined. For an 18-year-old, former-high-school student with no prior military experience, the shock one faces being thrust into a military environment can be extremely stressful. The punishing heat and

humidity associated with summertime in Annapolis only add to this stress. While the results of this research do not prove a noticeable link exists between high temperatures and attrition, it is clear that high temperatures and stress decrease the Quality of Life in an already stressful environment. One of the focus areas identified in the Naval Academy's Strategic Plan is Academy Quality of Life. The failure to install air conditioning into midshipmen living spaces is counter to this goal. Installing air conditioning in Bancroft Hall would ease the stress associated with the heat and may be enough of a factor to help some midshipmen endure the first weeks of plebe summer, become acclimated to the military lifestyle and go on to graduate. In addition to installing air conditioning in Bancroft Hall, the Academy should also research the feasibility of modifying the plebe summer schedule such that the midshipmen attend events in air-conditioned buildings during the hottest periods of the day.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

This thesis identifies several areas for future research. The focus of this thesis was independent variables from a midshipman's pre-academy life and how well those variables predicted plebe summer attrition. This same model could be expanded to determine the predictive ability of these same variables on issues such as plebe year completion, Naval Academy graduation or fleet retention and promotion. Additionally, as the model is expanded to include significant periods of time at the Academy, other independent variables that develop while a midshipman is enrolled in the Academy (such as GPA, military grades) could be included in the model.

The sample in this model could also be divided into subgroups for further analysis. For example, the midshipmen who exceeded the limits of the height/weight table and are not recruited athletes could be specifically analyzed to determine if their struggles are limited to the physical environment of plebe summer or if these midshipmen continue to struggle on the semi-annual physical readiness test (PRT) midshipmen take for the duration of their four years in Annapolis. A future thesis topic could focus solely on those midshipmen who fail the PRT and see if any entry-level variables exist that predict who these midshipmen will be.

Further research is also possible into the relationship between plebe summer temperatures and attrition. This researcher speculates that the majority of the plebe

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summer attrition occurs during the first half of plebe summer due to the enormous shock experienced during this period. A future study could determine when during plebe summer that attrition occurs, and see if a stronger relationship develops between the average high temperature from the first half of plebe summer and the number of midshipmen who attrite during the first half of plebe summer.

It is also important to realize the results from this study represent a snapshot in time taken at the Naval Academy from the summers of 1995 to 2002. It would be beneficial to replicate this study in the future (perhaps every five to ten years) to determine if the variables that are predictive of plebe summer attrition remain constant over time or change with future generations of midshipmen.

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APPENDIX A. VARIABLES IN THE DATA SET FOR ANALYSIS

Name	Variable Description	Descriptive Statistics	
attps	Dependent Variable Whether or not an individual completed plebe summer (1 = yes, 0 = no)	Valid N	9,554
		Yes	8,993
		No	561
		Mean	.94
		S.D.	.24
gender	Independent Variable The gender of each individual (1 = female, 0 = male)	Valid N	9,554
		Female	1,566
		Male	7,988
		Mean	.16
		S.D.	.37
minority	Independent Variable Whether or not an individual is a minority (1 = minority, 0 = majority)	Valid N	9,554
		Minority	1,912
		Majority	7,642
		Mean	.20
		S.D.	.40
minority-male	Independent Variable Whether or not an individual is both a minority and a male (1 = minority-male, 0 = other)	Valid N	9,554
		Minority-Male	1,571
		Other	7,983
		Mean	.16
		S.D.	.37
majority-female	Independent Variable Whether or not an individual is both a majority and a female (1 = majority-female, 0 = other)	Valid N	9,554
		Majority-Female	1,225
		Other	8,329
		Mean	.13
		S.D.	.33
oos_wgt	Independent Variable Whether or not an individual satisfied height/weight standards at induction (1 = out-of-spec, 0 = in-spec)	Valid N	9,554
		Out-of-Spec	1,097
		In-Spec	8,457
		Mean	.11
		S.D.	.32
oos_non	Independent Variable Whether or not an individual exceeded height/weight standards at induction and was not a recruited varsity athlete (1 = out-of-spec, non-athlete, 0 = other)	Valid N	9,554
		Out-of-Spec, Non Athlete	629
		Other	8,925
		Mean	.07
		S.D.	.25
satm	Independent Variable Score on math section of SAT Maximum possible value is 805 due to renorming of the SAT	Valid N	9,554
		Minimum	420
		Maximum	805
		Mean	661.94
		S.D.	63.21
satv	Independent Variable Score on verbal section of SAT Maximum possible value is 805 due to renorming of the SAT	Valid N	9,554
		Minimum	360
		Maximum	805
		Mean	636.73
		S.D.	66.31
wpm	Independent Variable WPM utilized by Admissions Board	Valid N	9,554
		Minimum	51,651
		Maximum	84,019
		Mean	65,699.54
		S.D.	4,602.82

Name	Variable Description	Descriptive Statistics	
athlete	Independent Variable Whether or not an individual is a recruited varsity athlete (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 2,776 6,778 .29 .45
sum_sem	Independent Variable Whether or not an individual attended the Naval Academy Summer Seminar (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 2,898 6,656 .30 .46
age	Independent Variable Age on induction day in years	Valid N Minimum Maximum Mean S.D.	9,554 17 23 18.75 .98
milfath	Independent Variable Whether or not an individual's father had military experience (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 3,675 5,879 .38 .49
milmoth	Independent Variable Whether or not an individual's mother had military experience (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 395 9,159 .04 .20
milpar	Independent Variable Whether or not either parent had military experience (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 3,788 5,766 .40 .49
par_acad	Independent Variable Whether or not either parent graduated from a service academy (1 = yes, 0 = no)	Valid N Yes No Mean S.D.	9,554 447 9,107 .05 .21
wk1_t	Independent Variable Average daily high temperature for week 1 of plebe summer (F)	Valid N Minimum Maximum Mean S.D.	9,554 82.3 94.3 87.41 3.93
wk2_t	Independent Variable Average daily high temperature for week 2 of plebe summer (F)	Valid N Minimum Maximum Mean S.D.	9,554 83.7 91.9 86.15 2.54
wk3_t	Independent Variable Average daily high temperature for week 3 of plebe summer (F)	Valid N Minimum Maximum Mean S.D.	9,554 81.1 94.9 90.15 4.91

Name	Variable Description	Descriptive Statistics	
wk4_t	Independent Variable Average daily high temperature for week 4 of plebe summer (F)	Valid N	9,554
		Minimum	77.3
		Maximum	94.1
		Mean	86.69
		S.D.	5.17
wk5_t	Independent Variable Average daily high temperature for week 5 of plebe summer (F)	Valid N	9,554
		Minimum	81.6
		Maximum	96.9
		Mean	88.09
		S.D.	5.35
wk6_t	Independent Variable Average daily high temperature for week 6 of plebe summer (F)	Valid N	9,554
		Minimum	83.3
		Maximum	94.1
		Mean	86.94
		S.D.	3.02
wk7_t	Independent Variable Average daily high temperature for week 7 of plebe summer (F)	Valid N	9,554
		Minimum	79.6
		Maximum	96.4
		Mean	87.99
		S.D.	5.61
half_1t	Independent Variable Average daily high temperature for the first half of plebe summer (F)	Valid N	9,554
		Minimum	83.0
		Maximum	91.3
		Mean	87.91
		S.D.	2.91
half_2t	Independent Variable Average daily high temperature for the second half of plebe summer (F)	Valid N	9,554
		Minimum	82.3
		Maximum	92.0
		Mean	87.24
		S.D.	3.28
total_t	Independent Variable Average daily high temperature for the entire plebe summer (F)	Valid N	9,554
		Minimum	82.2
		Maximum	91.4
		Mean	87.44
		S.D.	3.26

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